in the tropics. The southern field is so far absorbed in the heat of the tropical zones as to have no known definite effect upon the weather from day to day; the arctic field, on the contrary, has a persistent though loose tendency to excite the atmospheric circulation to form highs and lows in a peculiar sequence. Hence, it is the variations in the horizontal and vertical components of terrestrial magnetism from day to day that best measure the solar energy involved in the production of northern storms. The systems of force just specified are magnetic, so adjusted as to make mean angles at the surface of the earth, and a constant value for each station, so that the total impressed force is on the average proportional to the horizontal component. Hence, in studying relative variations, this latter can be used as an approximate substitute for the total force, and the bifilar becomes the instrument for useful work. If bifilars could be placed in the zone of the maximum frequency of auroras, they might be a fairly reliable measure of the quantities desired. Unfortunately the observatories available (Toronto, Washington, and San Antonio) are all located in the zone where the exflected and the inflected systems meet together, and there is, in consequence, a very unsteady direction to the impressed field, so that the horizontal component cannot be supposed to hold a very constant ratio to the total vector. Therefore, within this zone the action of the bifilar can only imperfectly record the changes in the solar field, though it is evidently much more valuable than the declinometer or the Lloyd's balance. In the curves published in the WEATHER REVIEW no attempt was made to correct for temperature or other instrumental conditions, because it was desired to see how far the readings of the bifilar could be utilized in their crudest form, such as might be necessary to adopt in any extended use of this form of apparatus. A reasonable steadiness of temperature, and photographic registration of the trace can be secured at very inconsiderable outlay for equipment and maintenance.

With regard to the meaning of the magnetic curves, the following considerations must be mentioned. The primary cause of atmospheric circulation is, of course, the equatorial accumulation of heat from the electro-magnetic radiation of the sun. This maintains a system of atmospheric circulation of warm and cold currents of a very complex character, which are chiefly the source of the highs and lows seen upon the daily maps. My researches show that the magnetic energy of the polar field is added to this as a secondary source of action; it supplements, but does not supersede, the former. The probability is that 25 or 30 per cent of the disturbances in the weather conditions of the region designated as "the extreme northwest" will be traced to this source, from whence the extension and dissipation occurs chiefly in the United States. But it must not be overlooked that prevailing conditions are largely due to tropical convection, and that the synchronism between this and the polar magnetic energy may often become distorted. Such is the case in the summer, when the action due to the polar magnetism of the sun is greatly reduced in effectiveness, and in the winter, when the convectional discharges (*i. e.*, the cold waves) become very violent and disturb the fundamental magnetic pulsation (*i. e.*, the maxima and minima of the 26.68 period).

An examination of the curves of magnetic force and atmospheric pressure and temperature for the year shows that there is a synchronous variation maintained in all three curves for long intervals; that this harmonious beat is sometimes broken up, but soon restored. One should not expect to find such complete harmony as usually exists between the curves of mean daily pressure and temperature; it would be unphilosophical to disregard the well recognized facts that the instrumental conditions are incomplete, and that the effect of magnetic energy is not fully separated from the dominating convectional currents of the atmosphere. As matters now stand we see that (1) 75 per cent of the changes in the curvature of the magnetic curves agree quite well with those of the temperature and pressure curves; (2) that the amplitudes are about as reliable as the phases; (3) that the magnetic force is precedent, and that the highs and lows may lag a little in their formation; (4) that the fact that the magnetic observations are made 2,000 miles away to the southeast of the indicated seat of energy excludes the idea that the variations of atmospheric temperature were the cause of the simultaneous magnetic changes. These practical matters are clearly in a very elementary condition, but the prospects are good that they will be improved. For several reasons there is an increasing demand for better and more magnetic observations, so that it is very much to be regretted that one of our three American observatories has discontinued its operations, and that all three have suffered (especially as to the record of vertical force) by the introduction of electric trolley lines in their neighborhood. The Weather Bureau desires to acknowledge the courteous and generous cooperation it has received from the director of the magnetic observatory at Toronto, the superintendent of the Naval Observatory at Washington, and the superintendent of the U. S. Coast and Geodetic Survey which maintained a temporary observatory at San Antonio.

Beginning with the month of October, 1895, the presentation of the data will be given in a somewhat different form, aiming at greater accuracy in the comparison of the two types of physical elements.

NOTES BY THE EDITOR.

FLORIDA FREEZES FOR A CENTURY AND A HALF.

The following paper, read May 8, 1895, by George R. Fairbanks, is reprinted from pp. 16–20 of the Proceedings of the Eighth Annual Meeting, Florida State Horticultural Society. The data given in it will prove useful for future reference:

The earliest authentic record we have of severe cold weather in this State is in the year 1766, just after the transfer of the Floridas to England.

The night of January 2, 1766, John Bartram, the botanist, says, "was the fatal night that destroyed the lime, citron, and banana trees in St. Augustine, many curious evergreens up the river that were nearly twenty years old and in a flourishing state, the young green shoots of the maple, elm, and pavia, with many flowering plants and shrubs never before hurt."

Bartram, who was then camping on the St. Johns River above Volusia, says: "The morning of the 3d was a clear, cold morning; thermometer, 26°; wind, northwest. The ground was frozen an inch thick on the banks." Bernard Romans, in his Natural History of Florida (1775), says: "On January 3, 1766, a frost destroyed all the tropical productions in the country, except the oranges. The Spaniards called this a judgment on the place for having become the property of heretics, as they never had experienced the like."

In 1774 there was a snowstorm which extended over most of Florida. The inhabitants long afterwards spoke of it as an extraordinary white rain.

In 1799 the temperature was very low. On the 6th of April, 1828, a heavy frost was very destructive to vegetation; the temperature at Picolata was as low as 28°.

The great freeze, par excellence, occurred in 1835 on the 7th of February, when the temperature went as low as 7° above zero. John Lee Williams, writing in 1837, gives the following account of the great freeze of February, 1835:

"A severe northwest wind blew ten days in succession, but more violently for about three days. During this period the mercury was 7° below zero." [This is undoubtedly an error, and should read *above* zero instead of *below*.—G. R. F.] "The St. Johns River was frozen several rods from the shore, and afforded a spectacle as new as it was distressing. All kinds of fruit were killed to the ground. Many of them never started again, even from the roots. The wild groves suffered equally with those cultivated as far south as 28°."

He further remarks that in 1837 the wild orange groves south of Volusia and at New Smyrna were in full bearing, which shows that they were not much injured. In 1844 the writer saw very large sweet orange trees on Drayton Island bearing fruit, which could not have been killed down in 1835.

There has been some question as to the exact date of the freeze of 1835. I think there is no doubt that it occurred on the night of the 7th and morning of the 8th of February, 1835. Paragraphs in Nile's Register, February, 1835, state that the mercury was 1° below zero at Baltimore, and 1° above zero at Raleigh, N. C., on the morning of February 8, 1835. That month was excessively cold, the Chesapeake having been frozen so as to close navigation three times during that month. The mercury is reported to have been at 11° above zero at the same period at Fort King, Fla., then an army post near the present Ocala.

Dr. Baldwin of Jacksonville, an excellent authority, informed the Times-Union in 1886, that the date of the freeze in 1835 was the 8th of February, and the mercury stood at 8° above zero; and that about 1857, the day not given, the temperature was down to 16°. In 1857 the mercury fell to 26° at Tampa, 29° at Fort Pierce, and 30° at Fort Dallas, on the Miami. At Jacksonville the thermometer indicated, viz:

	°
January 16, 1857	16
December 28, 1872	27
January, 19, 1873	24
December 28, 1875	28
December 3, 1876	24
December 28, 1878	27
January 7, 1879	25
December 30, 1880	19
January 6, 1884	21
January 12, 1886	15

At Sorrento, on January 12, 1886, the thermometer indicated 19.

P. P. Bishop, in an address before the Fruit Growers' Convention, about 1872, said: "At Christmas, 1868, and again at Christmas, 1870, we had the two severest frosts that have been known in Florida since 1835. At each of these dates many young buds were ruined, many young seedlings frozen to the ground and much fruit destroyed."

With the foregoing statistics before us we are prepared to institute a comparison of the severe freezes we have had in Florida in 125 years at Jacksonville as a basing point.

	°
February, 3, 1766 (probably)	20
February 8, 1835	8
January 12, 1886	15
December 20, 1894	14
February 8, 1895	14

In 1766 the effects of the freeze were confined to loss of tropical plants, etc. That of 1835 destroyed all oranges, lemons, etc., north of 28° N. Lat. That of 1886 destroyed many young trees, and some old trees, but did not affect the crop of fruit in the following year in quantity, though it did in quality. The freezes of 1894-5 appear to have pretty generally killed down lemon trees, grape fruit, and young budded stock and many large trees; but according to present appearance (May 1895) old bearing trees will fruit for part of a crop the coming year.

In addition to the preceding, Mr. Fairbanks says:

Governor Glen of South Carolina, in a pamphlet published in London in 1761, says "that on the 7th of February, 1747, the temperature at Charleston was as low as 10° at 8 o'clock in the morning, and had been lower during the night; that all bearing orange trees were killed to the ground, and even an olive tree eighteen inches in diameter."

NOTE.—The lowest temperatures in Florida, as given by Schott in his temperature tables, are as follows:

Station.	Temperature.	Date.
Fort Barancas	10° F.	Jan., 1852
Fort Brooke	26	Jan., 1827, and 1857.
Fort Dallas	30	Jan., 1857
Fort Jefferson	42	Dec., 1868
Fort King	11	Feb., 1835
Fort Marion	21	Jan., 1831
Fort Meade	24	Jan., 1852
Fort Myers	31	Jan., 1852
Fort Pierce	29	Jan. and Dec., 1851 and 1857.
Indian Key	47	Feb., 1836
Key West	44	Jan., 1857

For South Carolina, Schott gives:

Station.	Temperature.	Date.
Charleston	16	Jan., 1852
Fort Moultrie	6	Feb., 1835

DROUGHTS IN THE MISSISSIPPI VALLEY.

The annual report of the Iowa Weather and Crop Service, for 1894, contains an admirable article by the Director of the Service, J. R. Sage, on the "Drought Problem." Among the many excellent sentences we quote the following:

The question most vitally affecting the dairy industry is that relating to the permanence of the climatic conditions. Confidence is the basis of all business activity. We know what the past has brought forth, but what of the future? Are our droughty summers and hot winds to be the rule, instead of the exception, for many years to come? * * * The unusual experience of the past season has stimulated public interest in some of the problems of meteorology, and people are making the discovery that the tables and records of the weather clerks are not merely dry figures, after all, nor wholly devoid of value to practical people. The droughty season stimulated the growth of a great variety of theories and speculations. Now, it is a good thing to quicken inquiry and investigation, but it is still better to obtain correct answers. An interrogation point, like a corkscrew, may uncork healing balm or deadly poison. Can we make it rain? Why this extraordinary shortage of rain? What is the matter with our climate? Is this aridity the result of drainage and cultivation? These are questions that have agitated the community.

The author goes on to maintain that we can not make it rain, that neither rain nor drought are caused by human agencies, but by gigantic natural forces infinitely above the grasp of finite man. He shows that the records for past years demonstrate great variability in climates and in crops, but nothing to prove a permanent change. He gives a letter from the Hon. Charles W. Irish, describing the great drought of the summer of 1846, in Iowa, which corresponded to, and was, perhaps, a continuation of the drought of 1845, in Ohio, and that of 1844, in New England. From all appearances these three droughts were quite as severe as those of 1893-1895. He further shows how possible it is that droughts may be compatible with good crops of grain, if not of grass. As droughts alternate with very wet seasons, there is, therefore, no evidence whatever that civilization has affected the climate so far as concerns cloud and rain. The weekly Weather Crop Bulletin shows that the rain that usually falls over Iowa has simply passed by, and brought an excess to other sections. As the past is the best possible guarantee for the future, therefore we may still expect dry and wet seasons in about the average number and average irregularity. It is not well for man to give up in despair and retreat from the lands that he has attempted to occupy, but rather learn how, by forethought, to conquer a success in spite of the difficulties that nature presents. "By thorough drainage, subsoiling, the conservation of moisture by means of shelter belts of timber, artificial ponds, and artesian or deep wells, we shall, in time, be able to produce abundant crops and water our stock, whether the seasons be wet or dry."

THE WEATHER IN DISTANT REGIONS.

It has been abundantly shown that the prediction of the weather for a long time in advance must depend largely upon our knowledge of the conditions prevailing at the time of the prediction in different portions of the globe. In order to lay a proper foundation for the study of this subject we must have monthly, if not daily, charts of the temperature, pressure, moisture and winds over the whole globe, such as have been prepared and partly published under the title of International Simultaneous Observations. These charts for the years 1875 to the present time have been used hitherto principally as a means of studying the motions of low areas, or what is called the general circulation of the atmosphere in the Northern Hemisphere. Such studies have already shown that the phenomena of the Southern Hemisphere obey the same laws as hold good in the Northern Hemisphere, but in much simpler combinations, and that maps of both hemispheres, when compared together, mutually elucidate each other. It sometimes happened that cold, dry, and clear sea-